AGENDA SOCIAL

AFTER COVID-19, ALL CENTENARIANS?

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Life expectancy for humans averaged around 35 years until the end of the 19th century. Since then, it has more than doubled, especially in Mediterranean countries where it now reaches almost 85 years. According to the World Economic Forum, in 2040 Spain would be the country with the highest life expectancy in the world (85.8 years) and Italy would rank fifth (84.5 years). The impact of the Covid-19 pandemic will affect these predictions as both countries have had an excess of deaths during 2020. However, both countries exemplify the increase of life expectancy during the last 120 years.

The main factor promoting this increase in life expectancy is the development of antibiotics and vaccines that resulted in a marked decrease in bacterial and viral diseases that plagued our species throughout history. The current leading causes of death in the Western world, and especially in Europe, are dominated by coronary heart disease and cancer-related conditions. That is, diseases related to old age and poor eating habits in advanced societies. Nevertheless, infectious diseases are far from being eliminated as a threat, since bacteria and viruses continue to evolve and circumvent both natural and artificial barriers to infection.

The current global pandemic of Covid-19 has reminded us how exposed we are to infectious diseases. In the 21st century, we have been surprised by a virus, with a relatively simple molecular structure, for which we have no cure, so far. The announcement of the development of an effective vaccine, which could be deployed in the next weeks –or even days–, has finally raised great expectations as to whether we

are finally defeating the Coronavirus. However, the best efforts for the development and deployment of the vaccine has exceeded the one-year mark since the Sars-CoV-2 outbreak.

In our progressively robotized democracies, where an autonomous car is almost a reality, it **is surprising that current technologies of artificial intelligence (AI) and quantum computing are not being fully exploited to promote more rapid and dynamic antiviral strategies**. In the shadow of the pandemic and the prospect of being locked up most of the time, one would hope for an incentive to promote technology to finally deploy rapid solutions to infectious diseases. Let us remind that between the US and Europe, more than 2 trillion US dollars have been spent on research to cure all kinds of diseases. And yet, Covid-19 has hit humanity in every aspect. In addition, Covid-19 has overshadowed viral diseases that still claim millions of lives worldwide such as HIV and seasonal flu. The lethal Ebola virus outbreak in the past decade provides another striking example.

The fundamental problem in finding generic cures for viral infections lies in the amazing ability of these entities to mutate and evolve their infectious strategies. It is this variability that makes it extremely difficult to design an effective cure. **To beat the virus at its own game, we need to leverage technologies that draw on rapid predictions of potential mutations and to design an arsenal of therapies** that are ready to be deployed in the case of new outbreaks.

New technologies for quantum computing and pattern finding have allowed momentous developments that were unthinkable just 10 years ago. A notable example is language translators, such as Google's. This example is particularly relevant since we do not have a model of how human language works. Translation is achieved by trial and error of AI patterns searching algorithms and using a small learning set. That is, we can explore many possibilities in a very efficient way and find the right pattern. All of this will be even more efficient, by many orders of magnitude, with quantum computers.

Current technology to manufacture vaccines consists of developing, for each specific virus, an innocuous mimic that trains the human immune system to generate a response against the virus. This is not the place to give a technical description of current methods of creating vaccines, but an excellent description can be found here. In brief, vaccination is nothing more than using our defense system, which has been developed through evolution, to fight invasion by foreign agents. **Our evolutionary system works**

by trial and error or in other words on the basis of brute force; it is in a constant mode of learning.

The development of a vaccine against Covid-19 illustrates the possibilities and efficacy of current technologies. Advances in genomic sequencing and DNA and RNA synthesis techniques –which relied on advances in both experimental as well as computational methods– had allowed a record time in developing several effective vaccine candidates. Nevertheless, our fastest response required almost a year in development. Can we afford a new outbreak with all the toll it takes on lives and global economy? **Would it be possible to develop a generic or quasi-generic approach that would help reduce the devastating effect of viruses on society?**

Although vaccines had provided the *classical* effective solutions against viral diseases, the bottleneck for this approach lies in the lengthy clinical trials that are required for testing every individual vaccine in a *one bug, one drug* strategy. Therefore, more generic solutions are a pressing need. For instance, one approach for targeting viral diseases consists of small molecules –inserted in a pill– that would provide a chemical compound targeting and inhibiting the function of viral components. An example of this approach is the HIV triple cocktail therapy and the Hepatitis C virus (HCV) direct-acting antiviral tablets. The development of such compounds had so far relied on visualizing the interaction between the drug and the viral target using structural biology techniques such as x-ray crystallography and electron microscopy.

However, **advances in deep machine learning had allowed the prediction of molecular structures to a level of accuracy that matches those of experimental data up to 95% accuracy**. **Advances in computational modelling can allow us to predict mutations in the viral proteins** that may allow it to jump species to humans or become more virulent. Furthermore, it would also allow the exploration of a large space of design of small molecules that target these potential changes. In other words, we have the ability to predict evolutionary scenarios that a virus or family of viruses may undergo and be ready with the appropriate molecules to counteract it. In an ideal scenario, these algorithms may also allow us to identify patterns that are common among viruses that belong to the same families and to design compounds that target these conserved patterns. For instance, Sars-CoV-1, Sars-CoV-2, and Mers (which has a mortality rate of around 30%) all belong to the same family and share similar strategies for replication. The identification of the most conserved patterns may allow the design of Pan-viral molecules that inhibit all current and more importantly future members of this family.

A coordinated effort can be forestalled, as was done to decode the human genome. **The use of AI intelligence and quantum computing can facilitate the unfolding of quasi-infinite simulations that allow the preparation of a repertoire of compounds that is ready to circumvent potential virus outbreaks**. The combination of experimental and AI strategies in developing cures for viral diseases is just but one example that could be applied to a plethora of diseases that affect our longevity including cancer and a multitude of genetic diseases. But they have economic implications. For instance, the HCV direct-acting antiviral tablets cure entails **a very high cost of tens of thousands of US dollars per individual**. Here, it is worth bringing up the role of welfare states, as is the case of those of the European Social Model, providing the funding for these efforts as well as equal access to these therapies.

In EU countries the existence of national health systems (and other social protection institutions) minimize the social impacts of genetic diagnosis and the costs of universal therapies for all the citizenship. This is obvious in the case of health insurance, but is also true for labor contracts. Let us recall that one of the main motivations for some employers to demand access to genetic test results of their employees is related to their need to take out insurance policies with private companies which calculate the cost from previous experiences with the company in question. Can genetic information also be redefined in the terms in which social contracts, such as national health systems of universal coverage and the very existence of welfare states, are established? Genetic diagnosis and therapies can help achieve higher social well-being, but the possibility of discrimination, in particular against centenarians, can do away with the faith put into this human genetic engineering technologies.

In the light of such ongoing and potential developments, **our life expectancy could well increase up to more than 100 years in the foreseeable future**. What until recently seemed like a dream is now a real possibility. By the end of this XXI century, demographers such as James Vaupel argue that the longevity of people could reach 150 years. It can be counter argued that such is the type of projection which social scientists denominate *self-fulfilling prophecies*. In other words, they are extrapolations towards the future that, although they may be *false* or without robust data, arouse an interest in the people and actors involved, causing them to behave in such a way that they become *true*. The sociologist Robert Merton used to emphasize the force that implies that things are going to happen so that, finally, they happen.

Given the fact that we could live for more than 100 years and robots are going to occupy half or more of the jobs, how can we articulate a productive, social and egalitarian society where 'entrepreneurship' and welfare can be fostered to all? The Covid-19 pandemic has caused an acceleration in the use of robots. After all, they do not get sick and are not susceptible to being infected. A recent study by the World Economic Fund indicates that in about 5 years half of the jobs will be carried out by robots. TTR (*tax the robot*) provides a good policy to be implemented and, in so doing, making possible the extension of basic income and citizens' well-being. This is more than ever necessary given the increasing degree of inequality that has accelerated by the impact of the Covid-19. Today, the 50 richest US Americans hold as much wealth as their 165 million poorest compatriots. Figures speak for themselves. Living longer could end up as a self-defeating strategy that may drift into the eugenics of eliminating centenarians in poverty. That may be the aim of policies which seek the discrimination –and even elimination– of those who are already in weak social positions, as the elderly frail.